TIMES demo models

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Publication date:
2013

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EFDA-TIMES and ETSAP-TIAM Workshop
DTU Risø Campus, Roskilde, Denmark
back-to-back with
64th Semi-annual ETSAP meeting, Seoul, Republic of Korea
Program continuing in Denmark with Skype connection to remote participants

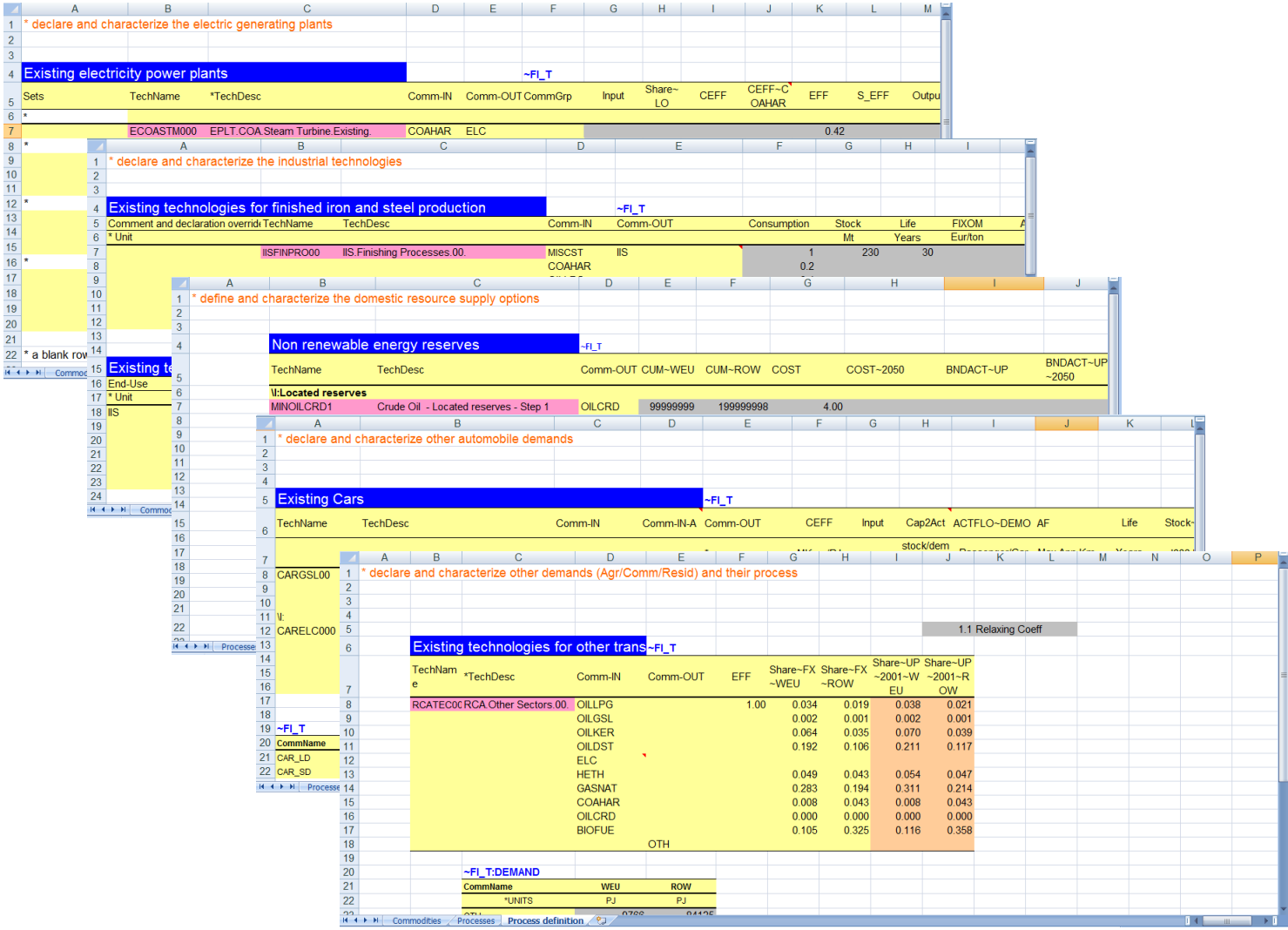
DeustoTech Energy
e4sma
DTU Technical University of Denmark

Overview

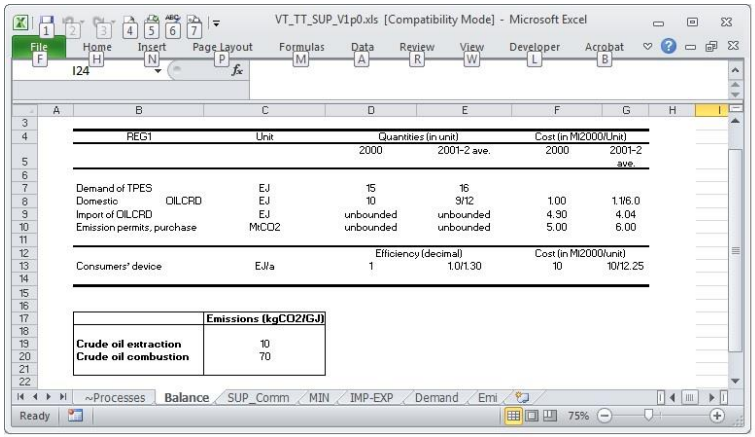
- Survey of TIMES demo models
  - **VEDA-TIMES demo v.48**: shipped with VEDA for test of new installations and updates
  - **TIMES_tutorial**: very small model for starters
  - **7-step tutorial**: used for training, Cape Town 2010 and later
  - **KanOrs-EMR library / VEDA forum**
- Time slices for energy demand and variable generating units
- Further development: SubRES and generic regions

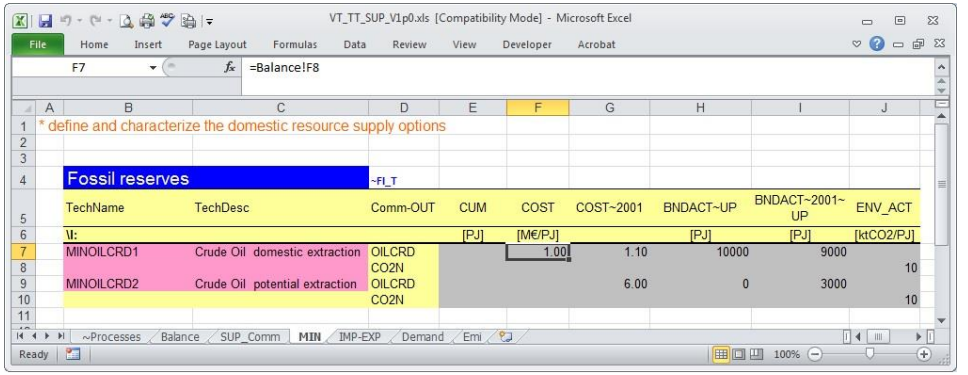
VEDA-TIMES demo v.48

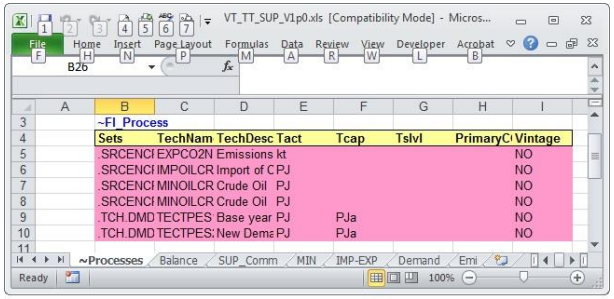
- Sectors
  - Electricity
  - Industry
  - Supply
  - Transport
  - Other

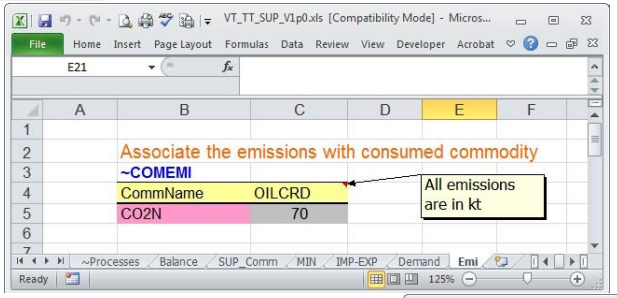


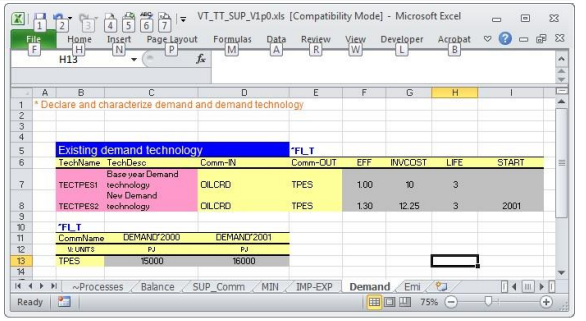
TIMES_TUTORIAL

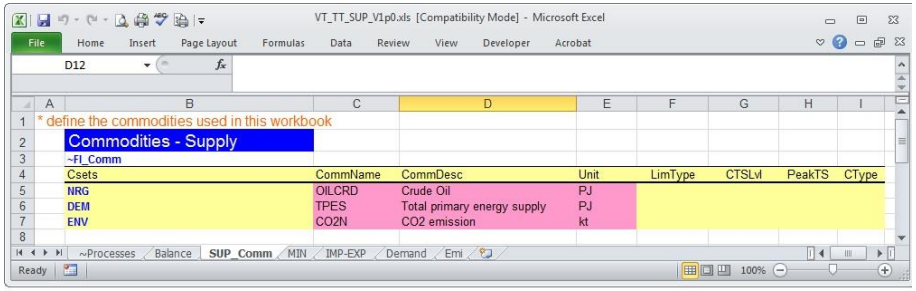


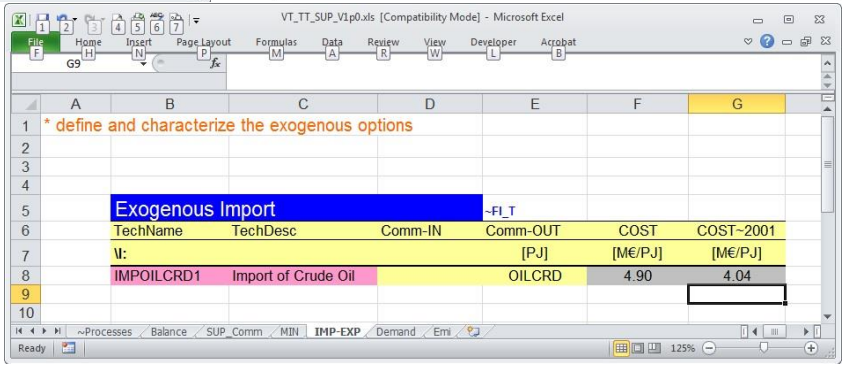






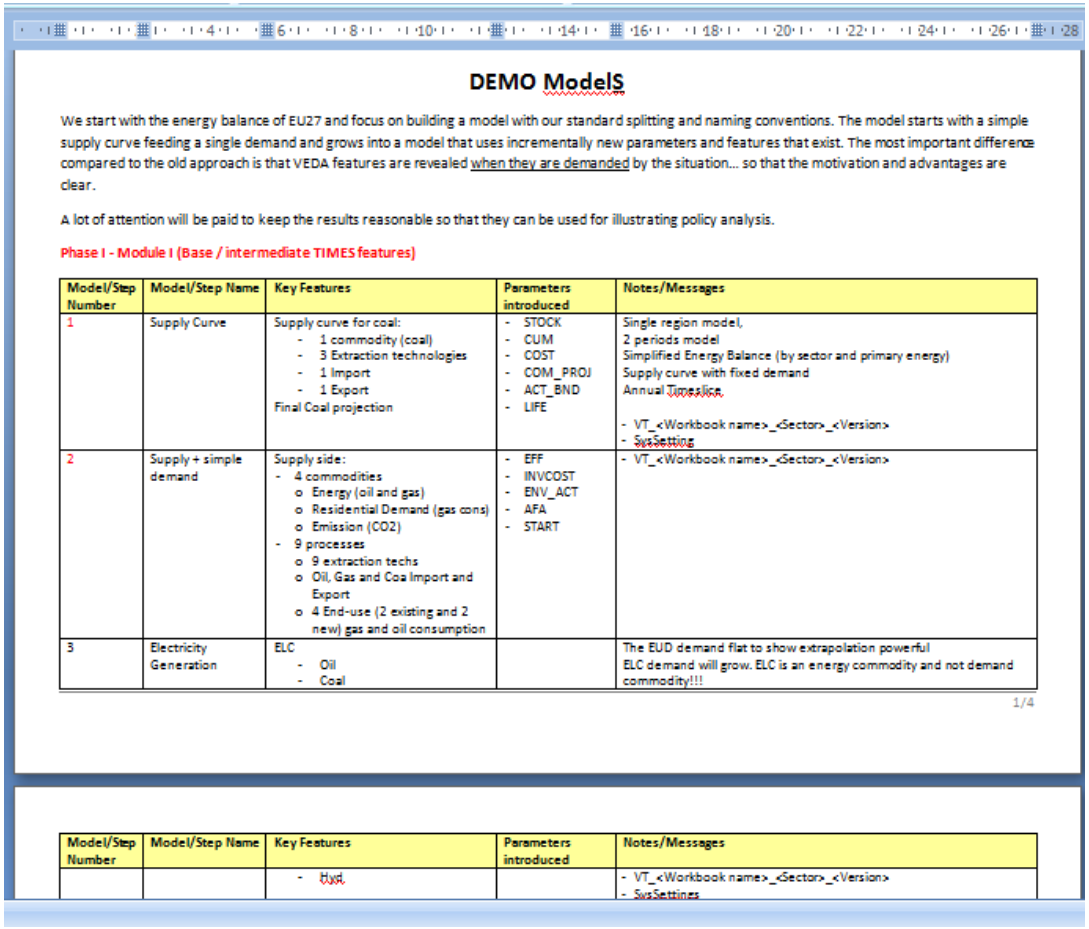






7-step tutorial

- Step-by-step approach:
  - Supply curve
  - Supply + simple demand
  - Electricity generation
  - Electricity sophistication
  - Multi-regional approach
  - …



DEMO ModelS

We start with the energy balance of EU27 and focus on building a model with our standard splitting and naming conventions. The model starts with a simple supply curve feeding a single demand and grows into a model that uses incrementally new parameters and features that exist. The most important difference compared to the old approach is that VEDA features are revealed when they are demanded by the situation… so that the motivation and advantages are clear.

A lot of attention will be paid to keep the results reasonable so that they can be used for illustrating policy analysis.

Phase I - Module I (Base / intermediate TIMES features)

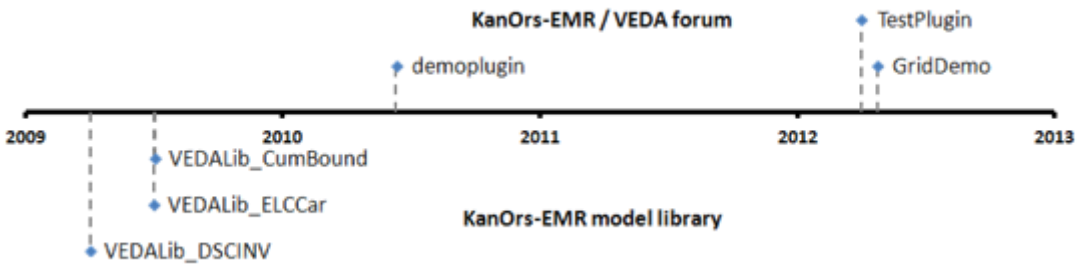
Model/Step Number	Model/Step Name	Key Features	Parameters introduced	Notes/Messages
1	Supply Curve	Supply curve for coal: - 1 commodity (coal) - 3 Extraction technologies - 1 Import - 1 Export Final Coal projection	- STOCK - CUM - COST - COM_PROJ - ACT_BND - LIFE	Single region model, 2 periods model Simplified Energy Balance (by sector and primary energy) Supply curve with fixed demand Annual Timeslice - VT_<Workbook name>_<Sector>_<Version> - SysSetting
2	Supply + simple demand	Supply side: - 4 commodities o Energy (oil and gas) o Residential Demand (gas cons) o Emission (CO2) - 9 processes o 9 extraction techs o Oil, Gas and Coal Import and Export o 4 End-use (2 existing and 2 new) gas and oil consumption	- EFF - INVCOST - ENV_ACT - AFA - START	- VT_<Workbook name>_<Sector>_<Version>
3	Electricity Generation	ELC - Oil - Coal		The EUD demand flat to show extrapolation powerful ELC demand will grow. ELC is an energy commodity and not demand commodity!!!

1/4

Model/Step Number	Model/Step Name	Key Features	Parameters introduced	Notes/Messages
		- Hyd.		- VT_<Workbook name>_<Sector>_<Version> - SysSettings

Existing demo models in KanOrs-EMR library / VEDA forum

- **KanOrs-EMR support/model library**
  - VEDALib_DSCINV: Discrete investments
  - VEDALib_ELCCar: Electric car as night storage device
  - VEDALib_CumBound: Cumulative bounds on import process
- **KanOrs-EMR / VEDA forum**
  - demoplugin: Plug-in hybrid EV as night storage device
  - TestPlugin: 5 variants of plug-in electric cars
  - GridDemo: Electricity grids with power flow equations



VEDALib_ELCCar

Commodities

~FI_Comm

Csets	CommName	CommDesc	Unit	LimType	CTSLvl	PeakTS	Ctype
*Commodity Set Membership	Commodity Name	Commodity Description	Unit	Sense of the Balance EQN.	Timeslice Level	Peak Monitoring	Electricity Indicator
DEM	Heating	Heating Demand	PJ		DAYNITE		
	Cooling	Cooling Demand	PJ		DAYNITE		
	CarTravel	Travel By Car	PJ		DAYNITE		

~FI_Process

Sets	TechName	TechDesc	Tact	Tcap	TslvI	PrimaryCG	Vintage
\: Process Set Membership	*Technology Name*	*Technology Description*	*Activity Unit*	*Capacity Unit*	*TimeSlice Level of opm*	*Primary CommGrp*	*Vintage Tracking*
DMD,NST	Car_ELC	Electric CAR - NST version	PJ	PJ-Yr	DAYNITE		

~FI_T

TechName	Comm-IN	TimeSlice	Comm-OUT	START	NSTTS	Life	INVCOST	STG_EFF	FLO_MARK ~CarTravel ~UP	FLO_MARK ~CarTravel ~UP~0
Technology Name	*Input Commodity*	*TimeSlice(s)*	*Output Commodity*	*Starting Year*	*Charging TimeSlices*	*Lifetime of Process*	*Investment Cost*	*Storage Efficiency*	*Max Market Share*	*Mkt Share Extrapolate*
Car_ELC	ELC		CarTravel	2020		15	50	0.6	0.5	3
		SN,FN,WN,RN			1					

Timeslices

- Timeslice resolution in existing models

Timeslice level / Model	DEMO	TIAM	PET	TIMES-DK
Season	S, W	S, I, W	R, S, F, W	R, S, F, W
Weekly				WD, NW
DayNite	D, N	D, N	D, N, P	A, D, C, B
Total number of timeslices	**4**	**6**	**12**	**32**

- Electricity and heat demands are split into timeslices
- EV charging process vs Number of timeslices
- Demo models can serve as a first step towards understanding the potential role of EVs

Package of demos, tutorials - or models

All input files and Excel workbook for managing TIMES models

- Case names
- Select dd files
- Time slices

Operation

- Write run files
- Run GAMS model
- Store results

Tut_00	Tut_01	TT_CapeTown_Demo	TT_Cape_Town_Step4	TT_Cape_Town_Step5	Tutorial_Demo6	Tutorial_Demo6a	TT_Cape_Town_step_7	0	EC_start	HP1	TIMES_DEMO	CO2Tax
BASE	BASE	BASE	BASE	BASE	BASE	BASE	BASE		BASE	BASE	BASE	BASE
B-NewTechs	B-NewTechs					NEWTECHS			REF	REF	DEM_REF	DEM_REF
				CO2_BOUND		NEWTECHS-VINTAGE			ELCCAR	HEATPUMP	B-NewTechs	B-NewTech
		SysSettings	SysSettings	SysSettings		STORAGE	SysSettings		SysSettings	SysSettings		
							NEWTECHS				TRADEAttrit	TRADEAtt
							NEWTECHS-STORAGE					
IMP_Bound	IMP_Bound			TESTSCEN	TESTSCEN	TESTSCEN	NEWTECHS-VINTAGE					
				PKFLX			REFSCENARIO					
				RGASTEST			ELASTPAR					
	CO2N_Bound				CO2_BOUN	CO2_BOUN	ELC_CO2_BOUND			CUMBOUNDS		
				PKFLX	PKFLX	PKFLX	PKFLX					
				RGASTEST			PKRSV					
							TRA_CO2_BOUND					
							TRADE_PARAM					
							UC_CO2BND				UCTEST	UCTEST
							UC_GROWTH					CO2Tax
SysSettings	SysSettings				SysSettings	SysSettings					SysSettings	SysSettin
						VINTAGING						
ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL	ANNUAL		ANNUAL	ANNUAL	ANNUAL	ANNUAL
			S	S	S	S	S		S	S	S	S
			W	W	W	W	W		F	F	F	F
			SD	SD	SD	SD	SD		W	W	W	W
			SN	SN	SN	SN	SN		R	R	R	R
			WD	WD	WD	WD	WD		SD	SD	SD	SD
			WN	WN	WN	WN	WN		SN	SN	SN	SN
									FD	FD	SP	SP
									FN	FN	FD	FD
									WD	WD	FN	FN
									WN	WN	FP	FP
									RD	RD	WD	WD
									RN	RN	WN	WN
											WP	WP
											RD	RD
											RN	RN
											RP	RP

SubRES and generic regions / further development

- EFOM 1999: Combined heat and power (CHP) in EFOM 1999
- EFDA-TIMES 2005: Nuclear fusion based on the Power Plant Conceptual Study
- EFDA-TIMES 2012: Update of the fuel cycle for nuclear fission
- TIMES-DK 2013: 32 time slices for demand variations and wind resources
- EV-STEP 2013-2014: Electric vehicles

Conclusion

Technologies \ Regional level	World	Europe	Country	County/Region	City	Industry/ Campus
Electric vehicles						
…						
Distributed small-scale electricity						
…						
Large-scale electricity						

- Technologies described by SubRES
- Regions described by energy balance
- Testing of technology parameters combining regional level and sets of technologies

Downloads

- http://www.iea-etsap.org/web/docs/Files_Times_Tutorial.zip
- http://support.kanors-emr.org/ModelLib/VEDALib_ELCCar.rar
- http://support.kanors-emr.org/ModelLib/VEDALib_CumBound.rar
- http://support.kanors-emr.org/ModelLib/VEDALib_DSCINV.rar
- http://support.kanors-emr.org/forum/uploads/30/GridDemo.rar
- http://www.kanors-emr.org/VedaSupport/forum/uploads/30/demoplugin.zip
- http://www.kanors-emr.org/VedaSupport/forum/uploads/30/TestPlugin.zip